United States
Department of
Agriculture

Forest Service

Forest Pest
Management

Davis, CA

FORTH REPORT

NATIONAL STEERING COMMITTEE FOR MANAGEMENT OF SEED, CONE, AND REGENERATION INSECTS

Healthy Forests
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FPM 91-11
AUGUST 8, 1991

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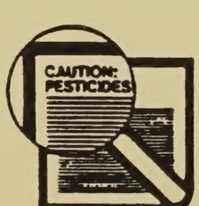
Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.



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NATIONAL STEERING COMMITTEE FOR MANAGEMENT OF SEED, CONE, AND REGENERATION INSECTS

Prepared by:

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Chairperson

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CONTENTS

I. INTRODUCTION

The 1991 meeting of this committee met at Boone, North Carolina. June 11-14, 1991. The meeting was hosted by Asheville Field Office, FPM, Southern Region. The committee spent two days in meetings and another two days to observe and discuss pest management in seed orchards, plantations, nurseries, and to observe forest decline. The committee changed its official name to National Steering Committee - Seed, Cone, and Regeneration Insects.

A. Members Attending

Larry Barber*	R-8/FPM (Asheville, NC)
Jed Dewey*	R-1/FPM (Missoula, MT)
J.B. Jett	North Carolina State University (Raleigh, NC)
Tom Hofacker*	WO/FPM (Washington, DC)
Steve Katovich*	NA/FHP (St. Paul, MN)
W.J. Lowe	Texas Forest Service (College Station, TX)
Alex Mangini*	R-8/FPM (Pineville, LA)
James L. McConnell	R-8/TM (Atlanta, GA)
Chris Niwa*	PNW/FIDR (Corvallis, OR)
Ron Overton*	NA/FRM (St. Paul, MN)
Nancy Rappaport	PSW/FIDR (Berkeley, CA)
Roger Sandquist*	R-6/FPM (Portland, OR)
John Taylor*	R-8/FPM (Atlanta, GA)
Darlene Tolman	R-8/FPM (Asheville, NC)
Keith Windell	MTDC (Missoula, MT)
Jack Barry* (Chairperson)	WO/FPM (Davis, CA)

Committee members are indicated by an asterisk (*).

Committee members absent were: J.R. Bridges, Scott Cameron, Gary DeBarr, Peter deGroot, Wayne Dixon, Mike Haverty, Dave Overhulser, Tim Schowalter, Kees VanFrankenheyzen, and Dave Rising. Keith Windell represented the MTDC technical staff at the meeting.

B. Purpose of Meeting

The purpose of the meeting was to identify national needs and establish priorities for managing seed, cone, and regeneration insects.

C. Definitions

Due to new and sometimes confusing terminology we decided to define some of the behavioral chemical terms. Thanks to Chris Niwa for providing these.

Biorational - Refers to semiochemicals in its narrowest use and all non-chemical uses in its broadest use. Best to avoid use of biorational as it means different things to different people.

Semiochemical - All chemicals acting as messages between organisms.

Allelochemical- Chemical signal between two species.

Allomone - Adaptive advantage to sender. eg. skunk's repellent, wasp's venom.

Kairomone - Adaptive advantage to receiver. eg. attraction of a parasite to the frass of a potential host, food attraction stimuli (attraction of a bark beetle to host tree volatiles).

Pheromone - Chemical signal between members of the same species. Can affect physiological development or behavior. Examples are:

sex attractant - eg. female pheromones in Lepidoptera;

aggregation - eg. bark beetle pheromones released to initiate "mass attack" of a host tree;

resource partitioning - eg. anti-aggregation pheromones of bark beetles;

trail - eg. ant pheromones used to orient other ants to food or new nest sites; and

alarm - eg. aphid pheromones used to warn other aphids of predators near by.

II. NATIONAL NEEDS AND RECOMMENDATIONS

A. National Needs and Priorities

The committee identified the following national needs and priorities, and developed recommendations, listed in order of priority with number 1 being the highest priority:

1. Develop and evaluate non-chemical control alternatives to include burning, behavioral chemicals, and biological control methods to manage seed, cone, and regeneration insects.

2. a. Develop timing mechanisms for initiating insect control activities.

   b. Develop monitoring and prediction systems for -

      Dioryctria spp.

      Cone beetles

      White pine cone borer and other *Eucosma* spp.

      Seed bugs (west)

      Douglas-fir cone gall midge

3. Identify and evaluate new insecticides for managing seed, cone, and regeneration insects.

4. a. Conduct field studies for reduced rates of the insecticide Guthion and other insecticides.

   b. Identify, evaluate and develop pheromone application equipment and techniques.

5. Determine impact and damage thresholds for -

   Seed bugs

   Cone and seed insects of western white pine, ponderosa pine, and white fir

   Complex of regeneration insects in ponderosa pine and lodgepole pine

   Western pine tip moth

6. Evaluate and validate coneworm spray timing model. (Note that model has been developed and is ready for evaluation and validation).

7. Improve application efficiency to seed orchards and wild collection sites. (Note that application efficiency is an important element to the success of National Needs numbers 1, 3, and 4, WO/FPM, May 1, 1991 technology development letter.)

8. Evaluate IPM simulation models for southern pines.

B. **Recommendations**

1. Approve and fund immediately a project to characterize the spray characteristics, spray deposition, and spray drift of and from ground sprayers used in seed orchards. The information is needed for the seed orchard EIS risk assessment and for model prediction of ground sprayer performance.

2. Establish a national steering committee for nursery and greenhouse pests.

3. Continue dialogue with EPA to facilitate relaxation of pheromone registration.

4. Develop a 5-year plan for improving management of seed, cone, and regeneration insects.

III. COMMITTEE MEMBER REPORTS

Members and non-committee members each gave a report on seed, cone, and regeneration insect management activities within their organizational and geographical work areas. They, along with some of the absent members, provided a written report for attachment to this report.

Reporter		Studies/Projects/Observations
Chris Niwa	a.	Use of colored sticky panels to monitor Douglas-fir seed chalcid populations
	b.	Development of chalcid in empty seed
	c.	Attraction of *Megastigmus albifrons* to gold sticky panels
	d.	Feasibility of mating disruption to control coneworms
Steve Katovich	a.	Evaluation of insecticide efficacy and utility of pheromone monitoring for cone and seed insects in northern conifers.
	b.	Burning to control *Conophthorus coniperda*.
	c.	Confirmation trials for *C. coniperda* pheromone.
	d.	Seed insects in hardwood orchards is a significant emerging problem in the North Central Region

Roger Sandquist

a. Reported on results of study applying esfenvalerate by aircraft to suppress Douglas-fir cone gall midge and seed chalcid damage
b. Ponderosa pine tolerance to western pine shoot borer.

Carl Fatzinger

Has a report available on a simulation model for integrated pest management in slash pine seed orchards.

Nancy Rappaport

a. Evaluation of contact insecticides for control of Douglas-fir cone gall midge.
b. Several other studies - see Appendix.

Jed Dewey

a. Evaluating pheromone baited traps for predicting Eucosma and Dioryctria populations and losses in western white pone seed orchards.
b. Testing light traps as a method of monitoring.
c. Evaluating efficacy of lower rates of Permethrin for seed bug control.
d. Conducting impact survey of lodgepole pine terminal weevil in R-1.
e. Using Hercon live tape pheromone strips to control western pine shoot in ponderosa pine test plantations.

Dave Overhulser

Evaluating Bifenthrin and Totalstat application technology for control of Lygus damage to 1-0 Douglas-fir seedlings.

Tim Schowalter

a. Studying effects of western conifer seed bugs on pine cone and seed production.
b. Studying timing of Douglas-fir cone and seed insect activity to cone phenology or weather variables.

Bill Lowe

Reported on needs and concerns of the Seed Orchard Pest Management Sub-committee of the Southern Forest Tree Improvement Conference.

Future needs for insecticides are:

Rate studies - both dosage and application interval;
Review of site classified insecticides and laboratory testing of most promising chemicals;
Review of new insecticides that may be useful; and
Develop ground equipment to simulate aerial application techniques.

Future needs for alternative control techniques are:

Operational evaluation of Foray[R];
field validation of degree-day models; and
mating disruption techniques.

Larry Barber Reported on status of four projects:

a. White pine cone beetle prescribed fire project;
b. Foray and capture insecticide studies;
c. Webbing coneworm pheromone disruption project; and
d. Simulated aerial spray technology project.

Keith Windell

a. Distributed four technology development proposals that MTDC prepared at request of Director, FPM.
b. Discussed his scoping of project "Ground and Aerial Pheromone Applicator Evaluation", (see Appendix).

IV. FIELD TRIP

Field trips were conducted June 13-14, 1991 in the vicinity of Boone, North Carolina. Sites visited were the Fraser fir Seed Orchard and Linville River Nursery operated by North Carolina Division of Natural Resources (NCDNR); private Fraser fir seed orchard; Watauga Northern Red Oak Seed Orchard operated by USDA Forest Service; Edward Seed Orchard (WPCB burning project and WPCB pheromone project) and nursery operated by NCDNR; and tour of Mt. Mitchell to observe forest decline affecting Fraser fir. Notes on field trip are in Appendix.

V. SUMMARY

The National Steering Committee - Management of Seed, Cone, and Regeneration insects met at Boone, North Carolina June 11-14, 1991. The first two days were spent identifying needs and setting priorities for actions to improve management of seed, cone, and regeneration insects. The other two days involved field trips to see pest management needs and activities at orchards, nurseries, and plantations. As follow-up to the committee meeting a memorandum was sent to Director, FPM (Washington) that listed identified needs by priority and other recommendations. The next meeting is planned to be held at Bellingham, WA or Vancouver, British Columbia July 14-16, 1992, co-hosted by Forestry Canada and the USDA Forest Service.

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APPENDIX
Chris Niwa

June 199
Chris Niw

1991 REPORT FOR THE NATIONAL STEERING COMMITTEE-- MANAGEMENT OF SEED AND CONE INSECTS

Christine G. Niwa, PNW Research Station, Corvallis, OR

Current Research:

1) Use of colored sticky panels to monitor population levels of the Douglas-fir seed chalcid. (Niwa)

Objective: To determine the feasibility of using gold colored sticky panels to predict population levels of the seed chalcid.

2) Exclusion study to evaluate the development of Douglas-fir seed chalcid in fertilized and unfertilized seed. (Niwa and Overhulser)

Objective: To determine if the Douglas-fir seed chalcid developes in unfertilized seed.

3) Monitoring adult *Megastigmus albifrons* flight activity with gold sticky panels. (Niwa, Stein and Binder)

Objectives: To determine if *M. albifrons* is attracted to gold sticky panels: and to assess differences in trap catch between panels hung in the upper or lower third of the tree crown.

4) Mating disruption of *Dioryctria* spp. using synthetic sex pheromone deployed in loblolly pine seed orchards. (DeBarr, Nord and Niwa)

Objective: To determine the feasibility of using mating disruption to control coneworms, *Dioryctria* spp., in loblolly pine seed orchards.

DOUGLAS-FIR SEED CHALCID MONITORING STUDY

METHODS: In 1989, seven seed orchards/blocks in Oregon were monitored. An average of one trap per acre, with a minimum of 10 and a maximum of 30 traps per seed orchard/block were checked twice a week throughout the chalcid flight period. Five cones per tree from one tree per acre (with a minimum of 100 and maximum of 300 cones) were collected from each location. Cones were processed, all seeds radiographed, and the percent damage calculated by counting the number of filled and chalcid infested seeds.

In 1990, two seed orchards were monitored as described above. In addition, nine blocks in two orchards that were part of an aerial spray test (see Sandquist) were also monitored. In these blocks, eight traps each were placed in treatment and check plots; and 80 cones per plot were used to determine damage levels.

RESULTS: The correlation of mean trap catch and percent infested seed was high for the 1989 data (R-squared = 98.8%). A regression of combined 1989 and 1990 data showed a low correlation (R-squared = 14.5%). This was principally caused by the 1990 Monmouth data which had an extremely high trap catch (almost 90 per panel) but only a moderately high amount of damage (about 20%). This lower than expected infestation may be due to lack of synchrony between the chalcid and cone development, as peak female flight occurred after most of the cones were beyond the stage in which they are susceptible to ovipostion. Without the 1990 Monmouth data, the regression shows a good correlation (R-squared = 87.7%) between trap catch and subsequent damage.

ADDITIONAL WORK: Work is continuing on development of a trap with the same reflectance as the Rebell panel, but which is disposable, less expensive, and readily available.

Cooperative Special Project

A special project to pilot test the monitoring system in Douglas-fir seed orchards in Washington, Oregon and California is being conducted in 1991-1992. This year 17 seed orchards/blocks are being monitored from mid-April through the first week of June.

DOUGLAS-FIR SEED CHALCID EXCLUSION STUDY

METHODS: In March 1990, bagging treatments were applied to 20 trees in Monmouth, OR. Four treatments with 40-60 cones per treatment were installed on each study tree. Treatments were as follows:

1) Paper bags over cones until harvest. This treatment excludes both pollen and DFSC and results in 100% unfertilized (empty) seed.

2) Paper bags through pollenation only, cones exposed to DFSC oviposition. Since all seeds in this treatment are unfertilized, the degree of DFSC infestation would be an indication of their ability to develop in empty seed.

3) Mesh bags over cones until harvest. Permits normal pollenation but excludes DFSC and other cone and seed insects, this gives an estimate of the potential number of filled and empty seeds without the confounding effects of insect damage.

4) Unbagged check. Cones are exposed to both pollen and DFSC, providing a measure of the natural levels of empty, filled and DFSC infested seed.

Cones were harvested in late August and all extracted seed was radiographed. Any branches in treatments one or two that had pollen contamination resulting in some filled seed were excluded from the study. Only trees with at least 20 cones in each treatment were used in the data analysis.

RESULTS:

After cone loss due to either conelet abortion or contamination, fourteen of the test trees had the required minimum number of cones. A few DFSC occurred in treatments one and three where they should have been excluded, this was due to wasp holes in bags and oviposition through mesh bags resting on cones, respectively.

DFSC were found in the pollen excluded treatment of all 14 trees. Damage ranged from 14-72% (mean = 50%) in check cones and from 6-79% (mean = 44%) in the unfertilized seeds. There is no statistical difference between DFSC infestation levels in seed from naturally occurring and unfertilized cones ($t = 1.81$, $df = 13$, $P = 0.09$).

DFSC will be reared from the check and unfertilized cone treataments to determine if there is a difference in either the proportion of adults emerging, or their sex ratio.

APPENDIX
Steve Katovich

June 1991
Steve Katovich

PROJECT: Cooperative Field Evaluation of Insecticide Efficacy and Utility of Pheromone Monitoring for Cone and Seed Insects in Northern Conifers.

PRINCIPLE INVESTIGATORS: Steve Katovich, Entomologist, USFS, S&PF, St. Paul, MN. Ronald Overton, Area Geneticist, USFS, S&PF, St. Paul, MN.

PROJECT OBJECTIVES: Test the efficacy of Dimilin, Asana XL, acephate and B.t. on seed and cone insects in northern conifers. Evaluate the utility of pheromones for monitoring *Dioryctria*, *Eucosma* and *Cydia* populations in northern conifer seed orchards.

PROJECT STATUS:

Pheromone Trials:

Eucosma tocullionana - White Pine Cone Borer - Pheromone confirmation trials at sites in North Carolina, Ohio and Wisconsin. First year of trials. Moth catches are being evaluated. Problems encountered include difficulty obtaining adult moths from field collected pupae for pheromone analysis and the unpredictability of *E. tocullionana* populations.

Eucosma monitorana - Red Pine Cone Borer - Pheromone confirmation trials at two sites in Wisconsin. Third year of study. Poor catch results though we do have information on the flight period which may improve control opportunities. Problems encountered include difficulty obtaining adult moths from field collected pupae for pheromone analysis, and difficulty identifying moths collected in sticky traps..

Dioryctria resinosella - Red Pine Shoot Moth - Very destructive in certain years and has not been controlled well in insecticide trials. Pheromone identification will be completed this summer. Current studies planned for this summer include final confirmation study, trap height study, bait age influence and cross attraction study with *Dioryctria disclusa*. Problems encountered include the length of the flight period which is approximately 1 month.

Cydia toreuta - Eastern Pine Seedworm - Pheromone previously identified. Data collected in 1989 and 1990 on degree day predictions for moth flight. Problems encountered include the inadequate supply of the pheromone.

Insecticide Trials:

Asana XL and acephate tested in red pine seed orchards in wisconsin in 1989 and 1990, Asana XL tested on a white pine orchard in Wisconsin in 1990. All results with both products were excellent. Seedbug problems are very low in Wisconsin, therefore only two early applications required. Field tests this summer are being conducted in a Scotch pine

survey will be conducted this year to update these acreage figures and obtain more information on cone and seed insect problems.

White pine, red pine, jack pine and white spruce make up the majority of the orchard acreage. Older orchards of all these species are beginning to produce significant amounts of seed.

Seed insects in hardwood orchards are the most significant emerging problem in this region. Red oak, white oak and black walnut orchards are being established in the Lake States and Central States in response to increased demand for hardwood planting stock. Forestry agencies in eight states have formed the North Central Fine Hardwood Tree Improvement Cooperative to increase breeding efforts in these species. Strategies for controlling hardwood seed pests is needed to support this effort. Walnut curculio has been found in older black walnut orchards, tree hoppers and leaf hoppers are being looked at as damaging agents of oak flowers, and acorn damage by other insects is well documented in natural stands.

APPENDIX
Roger Sandquist

June 91
Roger Sandquist

Effects of Aerial Applications of Esfenvalerate to Suppress Douglas-fir Cone Gall Midge and Seed Chalcid Damage in Maturing Seed Orchards

Roger Sandquist
USDA Forest Service
Pacific Northwest Region,

David Overhulser
Oregon Department of Forestry,

and John Stein
USDA Forest Service
Pacific Southwest Experiment Station

The objective of this study was to determine the effects of aerially applied esfenvalerate when targeted against gall midge and seed chalcid. Effects evaluated were: 1) phytotoxicity, 2) seed production and 3) population status of phytophagous mites.

METHODS

Orchard Description. Four blocks were treated at the Oregon Department of Forestry J. E. Schroeder Seed Orchard. This orchard is located in Sections 7 and 18, T.5S.R.2W., WM and Sections 12 and 13, T.5S.R.3W., WM at 170 feet elevation. The trees were 11 to 18 years old and ranged in height from 14 to 45 feet. Five blocks were treated at the USDI Bureau of Land Management Walter H. Horning Seed Orchard. This orchard is located in Sections 13 and 23, T.4S.R.3E., WM at 1200 feet elevation. The trees were 14 to 19 years old and ranged in height from 30 to 45 feet.

Insecticide. The aerial spray solution was 3.5 fluid ounces of Asana XL per gallon of water. Ten gallons per acre were dispensed for an application of 0.19 pounds of active esfenvalerate per acre. Rhodamine XB 400 at a concentration of 3.4×10^{-6} percent was added to the spray solution to facilitate assessment of spray deposit and drift sampling. The Asana XL formulation of esfenvalerate was chosen because of its known insecticidal effectiveness on the target insects, its approximately 7.5 day half-life in sunlight, and its rainfastness.

Application Equipment. A Hiller Soloy 12D equipped with a conventional spray system consisting of 37 Spraying Systems 8006 flat fan nozzles oriented straight down was used. The insecticide solution was applied at a boom pressure of 40 psi in a 40 foot effective swath width, 20 feet above the canopy at a velocity of 25 miles per hour.

Experimental Design. The test was a randomized complete block design. Nine experimental blocks were identified at the two seed orchards; four blocks (replicates) at Schroeder and five blocks at Horning. Each block had two plots; one assigned to the aerial application, and a second to the untreated control.

One ramet of one clone within the treated area at the Oregon Department of Forestry J. E. Schroeder

Seed Orchard was found to have off-colored foliage. Other ramets of the same clone within treated areas were observed not to have this symptom. It was concluded that the symptoms were unlikely to be related to the insecticide application.

Meteorological conditions were acceptable for aerial application and all applications were made as expected. A report (Lassila and Ekblad 1991) on meteorological conditions before and during the spray applications is available.

There was a substantial decrease in seeds destroyed by insects in the esfenvalerate treated areas (Table 1). The untreated areas had 26.2 percent of the seed destroyed by insects while the treated areas had 10.8 percent insect infested seed. Loss caused by gall midges was significantly reduced from 17.53 percent of seed in the untreated area to 9.78 percent in the treated area ($F=19.21$, $df=[8,1]$, $P=.0023$). Chalcid loss was significantly ($F=7.82$, $df=[8,1]$, $P=.0234$) reduced from 4.61 percent of seed in the untreated area to 0.21 percent in the treated area. Even though the percentages of seed bugs, cone moths and coneworms were low, they were reduced significantly; ($F=27.42$, $df=[8,1]$, $P=.0008$), ($F=15.01$, $df=[8,1]$, $P=.0047$) and ($F=10.05$, $df=[8,1]$, $P=.0132$), respectively.

There was no effect ($F=0.09$, $df=[8,1]$, $P=.7702$) of treatment on the percent of seed abortion. However, significantly ($F=5.46$, $df=[8,1]$, $P=.0476$) more seed were empty in the esfenvalerate treated areas. The empty seeds per cone increased from 26.1 percent of the total of all categories in untreated areas to 31.4 percent in treated areas.

Table 1. Comparison of percents of seeds in the seed categories of cones collected from aerially applied esfenvalerate treated and untreated orchard blocks.

	Mean percent of seeds (SE)	
seed category	untreated	esfenvalerate[1]
normal appearing	76.77 (3.60)	87.14 (2.72)**
seed chalcid[2]	4.61 (1.58)	0.21 (0.06)*
seed bug[2]	1.05 (0.18)	0.19 (0.05)**
empty[2]	34.82 (3.09)	36.80 (4.05)*
filled[2]	59.52 (4.46)	62.80 (4.06)ns
aborted	2.72 (0.05)	2.47 (0.38)ns
gall midge	17.53 (3.59)	9.78 (2.85)**
coneworm damaged	2.73 (0.74)	0.59 (0.19)*
cone moth damaged	0.25 (0.07)	0.03 (0.02)**

[1]** is significantly different at $P<.01$; * is significantly different at $P<.05$; ns is not significantly different.

[2]These categories are a subset of the category of normal appearing seed. For both untreated and esfenvalerate columns the percentages sum to 100 percent.

The net effect of treatment on seed production was an additional 6.77 filled, normal appearing seed per cone. While the differences in the percentages of filled seed were not statistically significant ($F=4.52$, $df=[8,1]$, $P=.0662$) at $P=.05$, this trend suggests that esfenvalerate applied aerially can increase seed production.

The average number of overwintering spruce spider mite eggs per shoot ranged from 14.6 to 57.5 in the treated areas and 0.8 to 12.1 in the check areas. There was a significant ($F=11.32$, $df=[6,1]$, $P=.015$) increase in spider mite eggs associated with esfenvalerate treated samples. These data suggest that repeated use of esfenvalerate will result in increased spider mite populations.

REFERENCE

Lassila, D. A. and R. B. Ekblad. 1991. Meteorological data supplement to aerial applications of insecticide in Douglas-fir seed orchards. USDA Forest Service Technology and Development Program Report No. 9134-2808-MTDC.

[illegible] $P = .002$) [illegible] increase seed production.

The average number [illegible] $P = .015$) [illegible]

[illegible]

Larsen, [illegible]

June 91
Roger

Preliminary Survey of Ponderosa Pine Evaluation Plantations to Determine if Certain Families Express Tolerance to Western Pine Shoot Borer.

Ray Steinhoff, Central Oregon Area Geneticist
USDA Forest Service
Pacific Northwest Region,

and Thomas W. Koerber
Entomological Service Company
Berkeley, California

The objective of this survey was to determine if families within two ponderosa pine evaluation plantations in central Oregon expressed any types of resistance to the western pine shoot borer, *Eucosma sonomana*. Because of the high incidence of shoot borer in parts of the Region and the average of 25 percent growth loss per year in each infested terminal, it was decided to see whether genetic mechanisms may be exploited to reduce this growth loss.

Initial evaluation indicates that, indeed, there are families which exhibit nonpreference or tolerance to this insect. Additional work on this subject is currently in abeyance until management direction indicates the approximate proportion of lands that will be planted in the future. Clearcutting areas and replanting has lost favor among various publics. The Forest Service and Bureau of Land Management haven't decided how much planting will be required to supplement natural regeneration. Also undecided is the direction of the tree improvement program.

APPENDIX
Carl Fatzinger

Fatzinga

A SIMULATION MODEL FOR INTEGRATED PEST MANAGEMENT IN SLASH PINE SEED ORCHARDS[1]

Carl W. Fatzinger
USDA Forest Service
Southeastern Forest Experiment Station
Olustee, Florida

Wayne N. Dixon
Florida Department of Agriculture & Consumer Services
Division of Forestry
Gainesville, Florida

Faced with the task of formulating pest management programs, most seed orchard managers rely on general theories that may not actually provide the answers for problems unique to their seed orchards. One management tool--a prototype simulation model--is now available. We developed the Simulation Model for IPM in Slash Pine Seed Orchards (SM-IPMSPSO) to provide seed orchard managers with the technology to rapidly predict and interpret the consequences of utilizing different IPM strategies on individual sites, and to facilitate the rapid utilization of survey data collected from these orchards for predicting seed yields.

Historically, seed orchard managers have lacked the technology to quickly predict and easily interpret the outcomes of different pest management programs. The consequences of modifying pest management programs usually were not known for two years because the efficacy of the modification cannot be measured until cone maturity. The prediction and interpretation process became even more arduous when integrating pest management alternatives with other orchard management practices. Conversely, SM-IMPSPSO rapidly evaluates the consequences of different pest management strategies in slash pine seed orchards within minutes on a personal computer. The SM-IPMSPSO also integrates available survey data and the results of other management practices into the predictive process. The model allows seed orchard managers to manipulate insecticides applied, application equipment and costs, insect damage rates, strobilus development rates and beginning populations, and insecticide efficacy rates to develop a pest management program that best fits their needs.

Programmed in QUICK BASIC for rapid execution, the SM-IPMSPSO simulates cone and seed production, pest damage, and insecticidal control in slash pine seed orchards. Simple rate equations are used to describe intermediate changes in the conditions and population densities of strobili and seed within an orchard over short periods of time. These changes, as well as the effects of pest damage, pesticide efficacy, and other perturbations, are accumulated throughout the development of the strobili. Seed orchard managers can use the models to estimate gains or losses likely to result from specific pest management strategies.

SM-IPMSPSO is designed to be user-friendly and will run on personal computers using MS-DOS. The model employs self-installation and configuration procedures for the convenience of the user. It is menu-driven for ease of use. Information and reports appear on screen. Printed reports are available.

APPENDIX
Nancy Rappaport

June 1991
Nancy

CURRENT STUDIES:

1. Impact of cone & seed insects, sugar pine, Sprague S.O. (Oregon). Beginning of 3rd year.
2. Impact of cone & seed insects, western white pine, Dorena S.O. (Oregon). Beginning of 3rd year.
3. Impact of cone & seed insects, sugar pine, Badger Hill Clone Bank (California). 1st of 3 yrs.
4. Sugar pine conelet abortion study, Badger Hill Clone Bank. Postponed until next year.
5. Isozyme study to identify species of *Megastigmus* in French conifers (14 sp. of *Abies*, 3 of *Larix*, 4 *Picea*, 1 *Cedrus*).
6. Isozyme study to quantify rate of apomixis (parthenogenesis) in Douglas-fir, and use of parthenogenic seeds by *Megastigmus spermotrophus* (adjunct: use of isozyme analysis to prove pollen exclusion was effective).
7. Similar study in ponderosa pine / *Megastigmus albifrons*, Foresthill S.O.
8. Trapping and characterizing host volatiles in Douglas-fir cones and foliage with goal of disrupting oviposition by *Megastigmus spermotrophus*.
9. Field test of Asana in western white pine.
10. Field test of dimethoate, Asana, Capture and Talstar in Dougla-fir for control of Douglas-fir cone gall midge (see attached report).

EVALUATION OF CONTACT INSECTICIDES[1] FOR CONTROL OF THE DOUGLAS-FIR CONE GALL MIDGE, Contarinia oregonensis Foote, IN OREGON SEED ORCHARDS - Nancy Rappaport[2], Charles Masters[3], Matthew Higgins[4], and Michael Haverty[2]

The Douglas-fir cone gall midge (DFCGM), Contarinia oregonensis Foote, is the most important pest of Douglas-fir seed production in the Pacific Northwest (Hedlin 1961, Schowalter and others 1985). Current recommendations for its control rely on the use of systemic insecticides, but the registrations of the two most commonly used systemics, dimethoate and meta-systox-R, are under review by the EPA and may be revoked. To provide efficacy data for replacement treatments for control of the DFCGM, we conducted field bioassays of two promising insecticides, esfenvalerate (as Asana[R]) and bifenthrin (as Capture EC[R] emulsifiable concentrate and Talstar[R] WP wettable powder).

Esfenvalerate and bifenthrin, which are synthetic pyrethroids, have shown promise in tests conducted in southern seed orchards against seed bugs and coneworms (Cameron 1989, Cameron and others 1987, DeBarr 1990). There is particular interest in bifenthrin because it may cause fewer secondary pest outbreaks than esfenvalerate (DeBarr 1990). Esfenvalerate is already registered for use in conifer seed orchards, but its efficacy against DFCGM has not yet been demonstrated. Our purpose for conducting this field bioassay was twofold. First, we intended to provide efficacy data against DFCGM to expand the label of Asana[R]. Second, we hoped to provide efficacy data to expand the labels of Capture[R] and Talstar[R] to demonstrate the efficacy of both bifenthrin formulations. Dimethoate (as Cygon 400[R]), a registered and effective compound, was included as a standard.

We used three study plots in two seed orchards: Springfield Block in Research Center Seed Orchard (Georgia-Pacific Corporation) near Cottage Grove, Oregon, and Coos Bay High Elevation and Longview Low Elevation Blocks (Weyerhaeuser Company) at Turner Seed Orchard near Turner, Oregon. The five treatments (Cygon[R], Asana[R], Capture[R], Talstar[R], and untreated control) were randomly assigned with at least 20 replicates per treatment. The unit of replication was the tree. Insecticides were applied with a hydraulic sprayer to the point of run-off, covering the entire crown of each tree. Numbers of trees per block were as follows: 101 trees at Springfield Block, 27 trees at Coos Bay Block, and 17 trees at Longview Block (total=145 trees).

Applications were timed to simulate operational strategies. Thus, esfenvalerate and bifenthrin, both contact insecticides, were applied when 50% of conelets were open to receive pollen, a treatment aimed at adult midges. Dimethoate, which is a systemic, was applied when all conelets were closed and most were half-pendant. This timing allows the systemic action of dimethoate to kill midge larvae after they have hatched and begun to tunnel into scale tissue. Earlier research (Rappaport and Volney 1989, Schowalter and Haverty, unpublished observations) has shown that pest species interactions may make it impossible to assess pesticide impact in Douglas-fir, where a complex of species develop in the same resource. To eliminate other pest species that might confound our results, we applied esfenvalerate two weeks after the dimethoate treatment and then again 30 and 60 days later.

Treatments were evaluated by dissecting a subsample of 5 cones after harvest to tally the percentage of galled scales per cone (Table 1). Although overall midge levels were low in Springfield Block in 1990, all four treatments significantly reduced galling by DFCGM (using Dunnett's test for comparison of treatments with the control; alpha=0.05). Results from Coos Bay Block showed no significant differences between treatments and the control. There were large apparent differences between the two treatments and the control in Longview Block, but, because of high variances, these differences were not significant at the 5% level.

[1]This article reports the results of research only. Mention of a proprietary product does not constitute endorsement or recommendation of its use by USDA.
[2]U.S. Forest Service, Pacific Southwest Research Station, P.O. Box 245, Berkeley, CA 94701
[3]Weyerhaeuser Company, P.O. Box 420, Centralia, WA 98531
[4]Georgia-Pacific Corporation, P.O. Box 1618, Cottage Grove, OR 97440

These results indicate that both esfenvalerate and the two tested formulations of bifenthrin can reduce galling caused by DFCGM, apparently through adult (and perhaps egg) mortality. All three insecticides, Asana[R], Capture[R], and Talstar[R], show promise as replacements for dimethoate for control of damage by DFCGM in Oregon seed orchards.

Table 1: Percent of scales galled/cone by DFCGM in three Oregon seed orchards:

Study Plot*	Control	Cygon[R]	Asana[R]	Capture[R]	Talstar[R]
Springfield, RCSO	9.27	**1.97	**3.01	**3.59	**1.43
Coos Bay, TSO	0.73	0.44	2.18	1.80	5.10
Longview, TSO	27.87	----	13.54	11.44	----

* RCSO=Research Center Seed Orchard; TSO=Turner Seed Orchard
**Values are significantly different from the control (alpha=0.05) using Dunnett's test

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APPENDIX
Jed Dewey

R-1 Cone and Seed/Regeneration Insect Projects/Activities

-1991-

I. Cone and Seed Insects

A. Monitoring

1. Evaluating pheromone baited traps for predicting *Eucosma* and *Dioryctria* population levels and subsequent losses in western white pine seed orchards.

2. Testing light traps as a method of evaluating population levels and predicting damage.

3. Periodic (every 2 weeks) examinations, visually observing a fixed number of trees and cones from the ground, and from a bucket trunk looking primarily for seed bugs.

B. Control

1. Evaluating the efficacy of a reduced concentration (1/2 registered rate) of permethri n for seed bug control.

II. Regeneration Insects

- Initiating an impact survey of the lodgepole pine terminal weevil in lodgepole pine plantations throughout Region 1.

- Operationally using Hercon live tape pheromone strips to control the western pine shoot in ponderosa pine test plantations.

Jed Dewey
Supervisory Entomologist
R-1

APPENDIX
Dave Overhulser

Dave Overhaulser

DRAFT WORK PLAN 2-1-1-500

Evaluation of Bifenthrin Rates and
TOTALSTAT Application Technology for
Control of Lygus Damage to 1-0 Douglas-fir Seedlings

Introduction

In western Oregon, Lygus hesperus Knight is recognized as a common cause of bud abortion and terminal growth deformation in bare root Douglas-fir (D.f.) seedlings (Schowalter, et al., 1986). At some conifer nurseries Lygus bug damage to 1-0 seedlings is significant enough to warrant insecticide applications. Multiple pesticide applications are necessary for Lygus control because the rapid growth of new seedlings and intensive crop of irrigation makes it difficult to maintain pesticide coverage (Overhulser, et al., 1986).

The standard treatment for Lygus control in conifer nurseries has been fenvalerate at .1 lb a.i. /A in 100 gallons of water. Within the last year production of fenvalerate has been discontinued and no evaluation has been made of a replacement insecticide for Lygus control. It is likely that a new insecticide, bifenthrin, can be used at a much lower rate than fenvalerate and provide adequate Lygus control. Testing and registering low rates of bifenthrin for Lygus control is one way to reduce the amount of insecticide used at the D.L. Phipps nursery and other bare root nurseries in Oregon.

Another method of reducing insecticide usage and costs is to test promising new application technologies. One such high efficiency application system, TOTALSTAT, will be available for evaluation in 1991. With the TOTALSTAT system, charged insecticide droplets are attracted to the plant surfaces coating them in a uniform manner. The active ingredient is applied in a vegetable oil carrier with a typical application rate of 1 pint per acre (Terronics, 1990). Such an application system would be ideal for treating uniform row crops like 1-0 and 2-0 conifer seedlings. In theory the amount of insecticide a.i. required for crop protection could be reduced by 1/4-1/2 with a high efficiency application. Application costs would be further reduced because the use of a low volume spray mean because applicators do not have to mix additional tanks of insecticide, a time-consuming task.

Objectives

1. To evaluate rates of bifenthrin, a replacement for fenvalerate, for control of Lygus damage to conifer seedlings.

2. To test the TOTALSTAT system for application of insecticide at conifer nurseries.

Material and Methods

Site: The D.L. Phipps Forest Nursery near Elkton, Oregon will be the site of this study. All insecticide evaluations will be conducted in the 1-0 Douglas-fir crop sown in Block 26. Sowing densities for these seedlings are 25/sq ft.

Oil Carrier: A vegetable oil, Terra Prime Oil II, has been chosen as the bifenthrin carrier to be used in the evaluation of the TOTALSTAT system. The oil carrier is applied at a volume of 1 pint/A using 10 micron droplets. At least two weeks prior to the bifenthrin test, Terra Prime Oil II should be sprayed on a small number of 1-0 seedlings. These test seedlings should be observed for at least 10 days for any signs of phytotoxic effects. To reduce the chance of phytotoxicity and spray drift, oil applications should take place in the morning when temperatures are cool and wind is not a factor.

Damage Phenology: Five 1 ft^2 sample plots will be located in the four check areas of the insecticide study. At the time of installation, the total number of seedlings present in the sampling frame will be counted. These plots will be monitored weekly starting in mid-July until the first Lygus damage is detected. Thereafter, plots will be monitored at two week intervals and the number of seedlings with Lygus damage recorded. The date damage is first detected anywhere in the study area will be used to time the start of bifenthrin applications.

Treatments: All bifenthrin treatments will start one week after initial damage symptoms and repeated at 2 week intervals until September (a maximum of 4 applications). All TOTALSTAT treatments will be compared with identical bifenthrin rates using an aqueous carrier. The bifenthrin formulation used in this study will be Capture 2EC.

The following treatments will be used in evaluating bifenthrin for control of Lygus damage to 1-0 seedlings (recommendation of Tom Leigh).

Treatment	
1. bifenthrin	.04 lb a.i. in 100 gal H2O/A
2. bifenthrin	.02 lb a.i. in 100 gal H2O/A
3. bifenthrin	.01 lb a.i. in 100 gal H2O/A
4. bifenthrin (TOTALSTAT)	.04 lb a.i. in 1 pint oil/A
5. bifenthrin (TOTALSTAT)	.02 lb a.i. in 1 pint oil/A
6. bifenthrin (TOTALSTAT)	.01 lb a.i. in 1 pint oil/A
7. Check	

The above treatments will be incorporated into a randomized complete block design with each treatment replicated four times. A treatment plot will be 38 ft. (6 beds) wide and 210-180 feet in length. Only the center two beds of each replication will be evaluated for Lygus damage.

Damage Evaluation: In October, the incident of seedling damage will be evaluated in twelve 2 $foot^2$ subplots located in the center two beds of each replication. All subplot locations will be randomly selected. The total number of seedlings in each subplot will be counted as well as the number with Lygus damage. No damage evaluation plots will be established in a 30 foot buffer zone at both ends of the bed.

Statistical Analysis: A $\bar{X}$ percent of Lygus damaged seedlings will be calculated for each replication. Differences between treatments will be tested by analysis of variance on arcsine-square-root-transformed percentages. Significant differences among treatment means will be tested using Tukey's test (Sokal and Rohlf, 1968).

Manpower and Equipment

Responsibility Key

P.M. - Paul Morgan (ODF)
D.O. - Dave Overhulser (ODF)
L.C. - Lisa Clemo (ODF)
E.E. - Eduardo Escallon (Terronics)

Activity	Time	Responsibility
Work Plan	May	D.O., P.M.
Phytotoxicity Testing	May - June	P.M., L.C
Coordinate with Terronics	June - July	P.M.
Coordinate with Insecticide Co.	June - July	P.M.
Obtain Oil Carrier	June - July	P.M.
Plot Marking of Establishment	July	L.C., D.O.
TOTALSTAT Training	July	E.E
Damage Phenology	July - Sept.	L.C., D.O.
Pesticide Applications	July - Sept.	P.M.
Damage Survey	October	L.C., D.O.
Data Analysis	November	D.O.
Reporting	December	D.O.

Equipment

1. Marking Stakes/flags
2. Terra Prime II oil
3. Bifenthrin
4. 1 Ft^3 sampling frames
5. Measuring Tape

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APPENDIX
Tim Schowalter

Tim Schowalter

Department of Biology
New Mexico State University
Las Cruces, NM 88003
7 May 1991

Dr. J. W. Barry
U.S.D.A. Forest Service
Washington Office
2121 C Second St.
Davis, CA 95616

Dear Jack:

I regret that I will be unable to attend the National Steering Committee on Management of Cone and Seed Insects meeting June 11-14. I will be returning from my sabbatical in New Mexico to Corvallis, OR at that time.

Two cone and seed insect research projects have continued at Oregon State University during the past year. The first is a cooperative study with Mike Haverty and Pat Shea on effects of western conifer seed bugs on pine cone and seed production at Dorena Tree Improvement Center in western Oregon. We have found that seed bugs caged on western white pine cones significantly reduce cone survival and seed production, with early season feeding increasing cone and seed abortion and late season feeding increasing empty and partially filled seed. I have enclosed a reprint from this study. Caging seed bugs on first year conelets apparently has no effect on cone or seed production. We also have caged seed bugs on sugar pine cones, but data from this study have not been analyzed.

The second study at Beaver Creek Seed Orchard in western Oregon is designed to relate timing of Douglas-fir cone and seed insect activity to cone phenology or weather variables. Cone buds on eight branches on each of 15 trees have been tagged in early March prior to insect appearance in 1989, 1990 and 1991. The eight branches have been assigned randomly to eight insect exclusion treatments: 1) no cage, insects have complete access, 2) caged entire season, insects have no access, 3) cage opened April 14-May 5, 4) cage opened May 5-26, 5) cage opened May 26-June 16, 6) cage opened June 16-July 7, 7) cage opened July 7-28, 8) cage opened July 28-August 18. If insect appearance is determined by photoperiod, then the window of activity should be the same each year. Conversely, if host or climate variables determine insect activity, then the window of activity should be related to these factors. Data for 1989 indicate that several cone and seed categories differed

significantly for the periods April 14-May 5 and May 26-June 16. The cone weevil, Lepesoma lecontei, damaged 30% of cones and the cone gall midge damaged 5% of seeds only in cages open April 14-May 5, while the seed chalcid damaged 2% of seeds only in cages opened May 26-June 16. Interestingly, numbers of filled seed were highest and empty seed lowest in cages opened April 14-May 5, suggesting possible interference with fertilization although Don Copes thought our 1 mm mesh size should allow for adequate pollination. Data for 1990 have not been analyzed.

I have enclosed two reprints dealing with our studies at Beaver Creek. One reports seed bug damage to Douglas-fir seed comparable to results for western white pine. The second describes our successful use of tree banding to control cone damage by the flightless cone weevil.

I have few suggestions for discussion items. The pectinase assay Pat Shea and Bruce Campbell have developed for assessing seed bug feeding provides a breakthrough for monitoring bug activity during the season and improving evaluation of bug damage at harvest. Seed bug has been an acknowledged but poorly evaluated seed insect that deserves increased attention. Other monitoring techniques such as pheromones for other insects still seem a priority. Also, seed orchards might lend themselves to biological control. Is anyone pursuing research on biological control for any cone or seed insect?

I hope you have a productive and enjoyable meeting. My regards to all.

Sincerely,

Tim

Timothy D. Schowalter
Visiting Associate Professor

APPENDIX
Bill Lowe

B. Lowe

IMPORTANCE OF TREE IMPROVEMENT AND SEED ORCHARD PEST MANAGEMENT IN THE SOUTH

Forestry is of major importance to the economy of the twelve southern states. The 184 million acres of timberland in the south produce approximately two-thirds of the domestic roundwood used for pulp and paper production, one-third of the timber used for lumber production, and about two-fifths of the timber used for veneer and plywood production in the nation. A substantial amount of miscellaneous timber products, such as poles, pilings, naval stores, etc., are also produced from southern forests.

To support his economic base, most organizations in the South (industrial, private non-industrial and public) have implemented artificial regeneration programs. Tree improvement programs have been developed to supply the seed needed for these regeneration efforts. Three tree improvement cooperatives have been formed to coordinate the efforts of 31 industrial organizations and 11 state agencies throughout the South. The attached table shows the combined membership of these cooperatives. Tree improvement efforts for the National Forests in the South are directed by Region 8 of the USDA - Forest Service.

These organizations intensively manage approximately 10,000 acres of seed orchards to produce the seed required for the artificial regeneration programs. While these seed orchards represent a very small area, their impact upon forest production in the South is very large. In 1987, these seed orchards produced sufficient seed to grow 1.3 billion seedlings which were used to reforest 1.8 million acres of land. This represented 85 percent of all reforestation efforts in the South. A conservative estimate of genetic gain for these seedlings is a ten percent increase in volume growth which has a present day value of $43.5 million. Additional value will be created by improvements in form and disease resistance.

Intensive management is critical to obtain the required amount of seed from these orchards. Cone and seed insect control programs are an integral component of a seed orchard management program because these insects can easily destroy over 50 percent of the potential seed crop. Cases have been documented where losses to cone and seed insects have exceeded 90 percent of the potential seed crop. Additional control techniques, both biological and/or chemical, are needed to insure a continuing supply of genetically improved seed for future reforestation efforts.

SOPMC

SEED ORCHARD PEST MANAGEMENT SUB COMMITTEE

SOUTHERN FOREST TREE IMPROVEMENT CONFERENCE (SFTIC)

Membership in Tree Improvement Cooperatives[1] in the South

Alabama Forestry Commission	Mississippi Forestry Commission
Arkansas Forestry Commission	N. C. Division of Forestry
Boise Cascade Company	Oklahoma Division of Forestry
The Bosch Nursery, Inc.	Packaging Corporation of America
Bowaters	Potlatch Corporation
Cavenham Forest Industries	Proctor and Gamble Cellulose Corporation
Champion International Corporation	Rayonier, Inc.
Chesapeake Corporation of Virginia	St. Joseph Land and Development Company
Container Corporation of America	Scott Paper Company
Deltic Farm and Timber Company, Inc.	S. C. State Commission of Forestry
Evergreen Corporation	Stone Container
Federal Paper Board Company	Temple-Inland Forest Products Corporation
Florida Division of Forestry	Texas Forest Service
Georgia Forestry Commission	Union Camp Corporation
Georgia-Pacific Corporation	University of Florida
Gilman Paper Company	Virginia Dept. of Forestry
International Forest Seed Company	Westvaco Corporation
International Paper Company	Weyerhaeuser Company
ITT Rayonier	Willamette Industries, Inc.
James River Corporation	
Kimberly Clark Corporation	
Louisiana Office of Forestry	
MacMillan Bloedel, Inc.	
Mead Coated Board	

[1]Cooperative Forest Genetics Research Program
University of Florida, Gainesville, Florida.

North Carolina State University-Industry Cooperative Tree Improvement Program, University of North Carolina, Raleigh, North Carolina

Western Gulf Forest Tree Improvement Program
Texas Forest Service, College Station, Texas

APPENDIX
Larry Barber

Larry Barber

Seed Orchard Pest Management Subcommittee
June 11, 1991

A. Formed:

1989 by Southern Forest Tree Improvement Committee

B. Members:

Geneticist: G. Hodges, J. B. Jett, W. J. Lowe, J. McConnell

Entomologists: L. Barber, S. Cameron, G. DeBarr, A. Mangini, J. Nord, J. Taylor,

Western Representatives: C. Masters, D. Overhulser

C. Objectives:

Determine the needs, establish priorities and provide coordination of field and laboratory work related to seed orchard pest management. Specific areas of activities are 1) keep chemical companies and the Environmental Protection Agency informed of our needs for currently registered pesticides, 2) coordinate efforts to relate needs and priorities to research groups, 3) coordinate efforts to test and register additional insecticides, and 4) coordinate efforts to implement new technology into operational programs.

D. Activities to Date:

1. Revised carbofuran label

2. Reclassification of seed orchards from forestry to terrestrial non-food sites

E. Current Activities:

Southwide bifenthrin study established in 1991 using six loblolly and three slash pine seed orchards.

F. Future needs:

1. Insecticides

   a. Rate studies - both dosage and application interval

   b. Review of site classified insecticides and laboratory testing of most promising chemicals

   c. Review of new insecticides that may be useful

   d. Develop ground equipment to simulate aerial application techniques

2. Alternative control techniques

   a. Operational evaluation of Foray®

   b. Field validation of degree-day models

   c. Mating disruption techniques

1991 REPORT FOR THE NATIONAL STEERING COMMITTEE

SEED AND CONE INSECTS

LARRY R. BARBER, FPM ASHEVILLE

Southern entomologists were involved in four Technology Development Projects during FY 1991. These were 1. White Pine Cone Beetle Prescribed Fire Project, 2. Foray/Capture Field Tests, 3. Webbing coneworm pheromone disruption project, and 4. Simulated aerial spray technology project.

WHITE PINE CONE BEETLE PRESCRIBED FIRE PROJECT-1991

BARBER, OVERTON, WADE, AND KATOVICH

1990-1991

N. C.--Edwards Seed Orchard: This was the second year of burning the orchard to control the white pine cone beetle. As last year the orchard was burned in February. This year the orchard grass was treated with a herbicide four weeks before burning to kill the fescue grass. Prior to the burn we found .77 live beetle/cone in our random cone samples as compared to none after the burn (Appendix 1). These random sample were collected from 100 cones found on top of the duff layer. In 1990 we found only .01 live beetle in the same type of random sample before the fire. This indicates an upturn in the overall beetle population from 1990 to 1991 (Appendix 2).

At the time of the fire, February 18, we tagged 20 trees to determine the success of the treatment. The inventory of the cone crop is incomplete at this time but through 4/29/91 only 12.24 percent of the cone crop had been killed by the WPCB (Appendix 3). As we had surveyed the surrounding windbreaks and found no overwintering beetles we are unsure of the location of the beetle population that invaded the orchard. The quality of the burn was such that no beetles survived within the orchard or other nearby sites that were burned. It is possible however, that some beetles within the orchard may have survived in cones that had not fallen from the trees.

Ohio--Mohican: We burned this orchard March 26, 1991. Unfortunately as the fire was burning through the orchard it began to drizzle or spit rain. This reduced the quality of the fire and a significant amount of grass was left unburned.

Even with the poor burning conditions the fire reduced the number of live beetles per cone from 2.52 before the burn to 0.74 after the fire (Appendix 4). Because of the remote area of this orchard we were not able to tag the cone crop for monitoring.

Ohio-Gifford: We were unable to burn because of inclement weather. The grass was never dry enough to burn. The healthy cone crop was reduced to 37.55 percent by May 29, 1991 the day of our most current crop inventory (Appendix 5). In 1990 the entire crop on this orchard was destroyed when the beetle population was reduced to 0.14 beetles per cone after the fire.

Wisconsin--Oconto River: This U. S. Forest Service orchard was burned April 22. The preburn random sample survey of 100 cones showed the presence of 1.68 live beetles per cone as compared to 0.14 live beetles after the fire (Appendix 6). In our preburn 50 square ft. sample plots we detected 10 beetles per plot (Appendix 7). There are no postburn 50 sq. ft. samples as raking to protect the trees destroys the integrity of the sample areas. Because of raking, pruning, and chipping of the brush many areas within the orchard did not burn satisfactorily. As these chips age and dry out and are covered by needles during the November 1991 leaf drop there will be a better chance for a completely sucessful burn next spring. The postburn random sample should be lower than 0.14 beetles per cone.

Because there was not a sufficiently large cone crop on the trees for 1991 no crop inventory data was taken. This fire was necessary to protect the developing flowers and conelets. This fire offered the opportunity to learn the techniques necessary to burn a Federal orchard before it becomes critical. This prescribed burn then became a dress rehersal for future pest management activities on the orchard.

New Hampshire: N. H. State Forest Nursery Orchard was burned April 5, 1991. A sample of 50 randomly selected cones collected before the fire and 100 cones after the fire indicate a treatment related reduction in beetle populations from 0.82 to 0.02 live beetles per cone (Appendix 8). Twenty trees were tagged during April and field crews are on site during the week of June 10 to re-inventory the orchard to determine the amount of WPCB damage.

New York: We visited in the fall of 1990 the Burnhill State Forest white pine orchard in N. W. New York. We decided not to burn this orchard because the branches on the trees needed severe pruning on nearly all trees. In addition most trees had heavy grass and vine growth near the trunk. This work needed to accomplished before burning could be initiated and unfortunately there was not sufficient time before winter.

We discussed attempting a fall burn in 1991 but no plans have been made.

WEATHER EQUIPMENT: Remote Artificial Intelligence Network (RAIN) weather stations were purchased and installed on white pine seed orchards in Ws., N. C., N. H., Penn., Oh., Tn., and Va. These stations collect weather data ie. temperature, rainfall, relative humidity and leaf wetness. These units cost approximately $2000 each and call to the Univeristy of Georgia nightly. From here the weather data can be downloaded to pc computer in any office in the country. These RAIN staions also posess the capability of transferring messages to and from any other base station.

White Pine Cone Beetle Pheromone Evaluation: The objective of this work was to compare release rates for +/- trans-pityol in order to develop a standard bait for use in trapping WPCB. Trapping locations were in Morganton, N.C., Buckingham, Va., Zanesville, Ohio, Pickett Tenn, New Hampshire, and the Oconto River in Wisconsin. Data are still coming in on this study in N.H. and Ws., however traps containing 100 ul of alpha-pinene in the N. C. orchard caught more beetles than all other baits combined.

FORAY/CAPTURE DEMONSTRATION PROJECT

BARBER AND MANGINI

1991-1992

CAPTURE:

The application of Capture has presented members of the Southern Seed Orchard Pest Committee with many challenges. The manufacturer, FMC has twice in the last two years reduced the amount of insecticide that we could apply in a single year. In November 1990 they announced that the most we could apply was 0.6 lbs ai/year. As we had tested the material at 0.2 and 0.3 lbs ai/treatment (5 treatments per year) we were faced with a serious problem. After much discussion we decided to proceed with a southwide test of Capture as is outlined in the accompanying study plan. Basically this test compares Capture, Guthion, and untreated trees. The test includes both slash and loblolly pine on 9 sites from Texas to South Carolina.

Our goal for this study was to evaluate D. disclusa damage in early June. These evaluations on the 6 participating

loblolly orchards will be completed by June 15. At the conclusion of the test we will count damaged cones from 36 pre-selected trees/orchard and extract seed from 6 cones from each tree. These seed will be radiographed to determine the amount of seedbug damage.

FORAY

Four test sites were identified for evaluating Foray 48B applied at 30 BIU's per acre. All sites will use Asana XL applied with the Foray at rates of 5.2 and 10.4 oz/acre. All of the sites will use micronair nozzles except at the Union Camp orchard where we are using 8002 flat fan nozzles. On all orchards the 1991 cone crops were tagged this spring. We have just started revisiting these orchards for mid-season inventories and no data are available. The four site for this southwide Foray test are in Mississippi, South Carolina Florida and Alabama. Three sites are loblolly and one is slash pine.

On the U. S. D. A. Forest Service orchard near Murphy, N. C. we are testing Foray to control coneworm stem attacks as well as on the cones. We will also use the IPM approach to controlling seedbuds where we sample trees and when the bugs are detected we will use Malathion to control the bugs. Application is via a FMC ground speed sprayer (mistblower). The Foray rate is 30 BIU's per acre.

WEBBING CONEWORM PHEROMONE DISRUPTION PROJECT

BARBER, DEBARR, MANGINI, NORD AND NIAWA

1990-1992

Entomologists and field crews from across the South treated 5 orchards during the spring of 1991 with D. disclusa pheromone at the rate of 5 grams active per acre. This was applied in lure tape at 1000 inches per acre.

Additional studies this year focused on determining the affects of trap density and trap location. Field crews also are in the final stages of counting D. disclusa damage on trees to determine the affects of last year's treatments. At the time this report was written none of last year's application results had been analyzed.

Significant time and effort this spring went into efforts to apply Agrisense pheromone beads via aircraft. These efforts failed when the sticker failed to hold the beads on the pine needles.

SIMULATED AERIAL SPRAY TECHNOLOGY PROJECT

MANGINI, CAMERON, BARBER, AND SANDERSON

1991-1992

Work on this project is just now getting underway. Dr. Sanderson, Dr. Cameron and Dr. Mangini met recently and discussed what would be done during the first year of the project. This work will be to further define what is normal spray deposit using aircraft to deliver pesticides to orchard trees and to begin to develop the equipment to artificially treat trees. Aerial application spray deposition monitoring studies are schedules for the Erambert orchard in Brooklyn, Ms. for late June and the Union Camp orchard in Hampton, S. C. for early July.

Plans are being drawn up to manufacture a ground spraying device to be used to simulate aerial spraying.

APPENDIX
Keith Windell

MESSAGE DISPLAY FOR BARRY, JACK

To Barry, Jack:SCS06
CC K.windell

From: Keith Windell:R01A
Postmark: Jul 08,91 5:17 PM Delivered: Jul 08,91 4:17 PM
Status: Certified
Subject: Reply to a reply: PHEROMONE USER GROUPS - UPDATE

Reply text:
From: Keith Windell:R01A
Date: Jul 08,91 5:17 PM
The Missoula Technology & Development Center plans to submit a project proposal entitled "Ground and Aerial Pheromone Applicator Evaluation" as part of its five year plan for FPM. This is being done in response to FPM's desire to see pheromone applicator methods and/or equipment improved. An initial telephone survey was conducted to identify some of the more outstanding problems with existing solid dispersal systems. Results of the informal survey are listed in the table "Pheromone Groups". The table does not claim to be comprehensive and anyone wishing to add information to the table is encouraged to contact Keith Windell at MTDC.

Unit	Personnel	Insect	Pheromone Carrier	Applicator
R-1 PSW	Ken Gibson Pat Shea	Douglas Fir & Lodgepole Pine Beetle	Phero-Tech (dry) beads & granules	Helicopter w/ modified simplex bucket & by ground.
PNW PNW PNW	Gary Daterman L. Sower Chris Niwa	Douglas Fir Tussock Moth	Sentry fibers	Fixed wing w/ dispenser.
		P-Pine Tip Moth	Hercon tape	Ground.
		Western Pine Shoot Borer	1. Hercon tape 2. PVC strips 3. Sentry fibers	Ground. Ground. Fixed wing w/ dispenser.
		Western Spruce Budworm	Hercon flakes	Fixed wing w/ dispenser.
R-8 SE	Larry Barber Gary DeBarr	Cone Worms	1. Agri-Sense beads	Fixed wing.
			2. Hercon tape	Ground.
			3. Nat. rubber septa	Ground.
AIPM Group	John Ghent Donna Leonard Dick Reardon Wynn McClaine Barbara Lenhardt	Gypsy Moth	1. Hercon flakes	Fixed wing w/ dispenser.
			2. Agri-Sense beads	Fixed wing.
R-10 PNW PSW	Ed Holslen R. Werner P. Shea	Spruce beetle	Phero-Tech bead	Helicopter.

Problem or comment
1. Application o.k. with modified Simplex bucket. 2. Problems with pheromone release rate from carrier.
Special dispenser required. Special dispenser required. Special dispenser required.
1. Cone worm beads clogged booms and nozzles. 2. Gypsy moth beads are smaller than cone worm beads and seem to come out ok. 3. Beads don't stick to foilage with "Staput". 4. Poor quality control of bead size distribution Requires bucket truck to get to top of tree crown Works fine in traps.
1. Baby powder added to dispensers to prevent bridging. Dispenser needs vibrator to keep flakes feeding. 2. Hercon owns all dispensers (about 25). 3. Requires special flake dispensers and modifications to aircraft to mount them. Problems due to bead/sticker interaction and plugged orifice (flat fan nozzle w/ diaphram).
Application w/ modified underslung Simplex bucket. Calibration problem.

APPENDIX
Field Trip Notes

June 13, 1991

FRASER FIR SEED ORCHARD
LINVILLE RIVER NURSERY

This Fraser fir seed production area was established in 1967-69 for two reasons. First, of course, is to provide the seed for superior planting stock. Secondly, the orchard will provide a means of perpetuating the species in an area where it can be protected from the Balsam Woolly Aphid.

The Fraser fir tree improvement program was implemented by the Division of Forest Resources, N. C. State University and in cooperation with the U. S. Forest Service.

Selection of trees for this seed production area initially numbered 300 trees. Selecting a Fraser fir tree for this seed production area was a rather tedious task. Probably, for each tree you see here, there may have been 100 trees graded in the field before the right one was selected. This may give you some idea of the strict grading system a tree must pass before being selected.

The seed production area is sprayed annually for the following insects: Balsam Woolly Aphid, Red Spider Mites, and Japanese Beetles.

(no longer being done as intensely, due to root damage causing root diseases)

Sub-soiling is done on a semi-annual basis. Although it hasn't actually been proven, there is a tendency to believe that sub-soiling promotes flowering.

Frasier sources
MT Mitchell
MT Roan
MT Rogers
MT Balsam

All sources of seedlings go to Christmas tree market - no reforestation.

- Damage to roots by cultural practices a problem due to shallow roots.
- Introduced pine sawfly, in white pine 1979, wasp parasite raised, released, and control successful.
- Spider mite controlled by granular di-system

- Poor seed viability in Frazier
- Balsam twig aphid and scale problem possibly due to pollen blockage
- Frazier like elevations >3,800', 4,500-6,000'

- Lindane applied for balsam wooly - use mist sprayer
- Trees grafted and others collected from field
- Demand for wild Frazier seeds
- Use root disease fungicides
- 3,500' elevations orchard
- Don Rogers
- Shelby ~~Hatt~~ Hawk

SEED ORCHARDS
RALPH EDWARDS NURSERY

Method of Establishment:

Select trees located by field personnel. Trees then graded by North Carolina State University Tree Improvement Cooperatives. Scion wood collected from select trees was grafted to root stock in line-out beds. Grafted material was transplanted to orchard following one growing season.

Objectives:

To produce seed for the nursery and to produce a superior quality tree through genetic testing both open and controlled pollination (progeny tests). Elements desired in a superior tree are fast growth, well formed crown, a straight main stem, and small branches perpendicular to the main stem that prune readily.

Accomplishments:

Species	Date Established	Spacing	Acreage	Clones Parent Trees	Avg. Ramet Per Clone
White Pine	1963	15 x 30	23	30	41
Shortleaf	1963	15 x 30	6.5	20	20
Va. Pine	1963	15 x 30	10	20	33.7
Sycamore	1970	15 x 30	2.3	40	4.5
Pitch	1970	15 x 30	1.67	16	7.9

Orchard Production in Bushels

Year	White Pine	Va. Pine	Shortleaf Pine	Fraser Fir
1972	52	5		
1973	--	39		
1974	3	46	0.25	6
1975	72	116	52	
1976	85	124	4	11
1977	--------- Unknown --------------			
1978	932	115	46	66
1979	480	98	36	59
1980	547	103	34	33
1981	658	53	39	148
1982	--	49	11	54
1983	957	106	14	101
1984	5,004	160	43	16
1985	--	66	--	16
	8,790	1,080	279	510

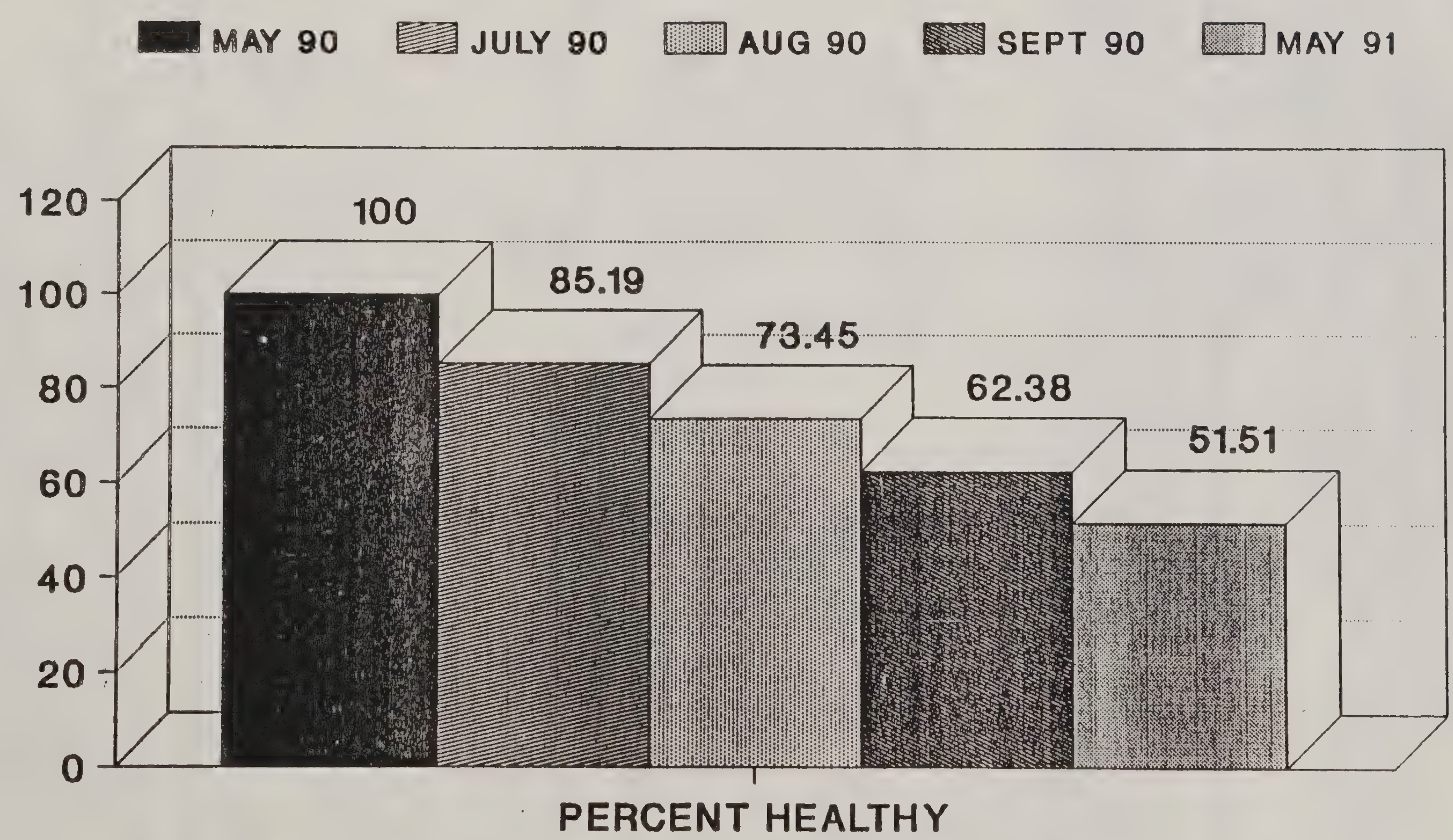
TABLE 1.

IMPACT OF THE BALSAM WOOLLY APHID (BWA) ON FRASER FIR, ITS ACREAGE, AND ITS OWNERSHIP

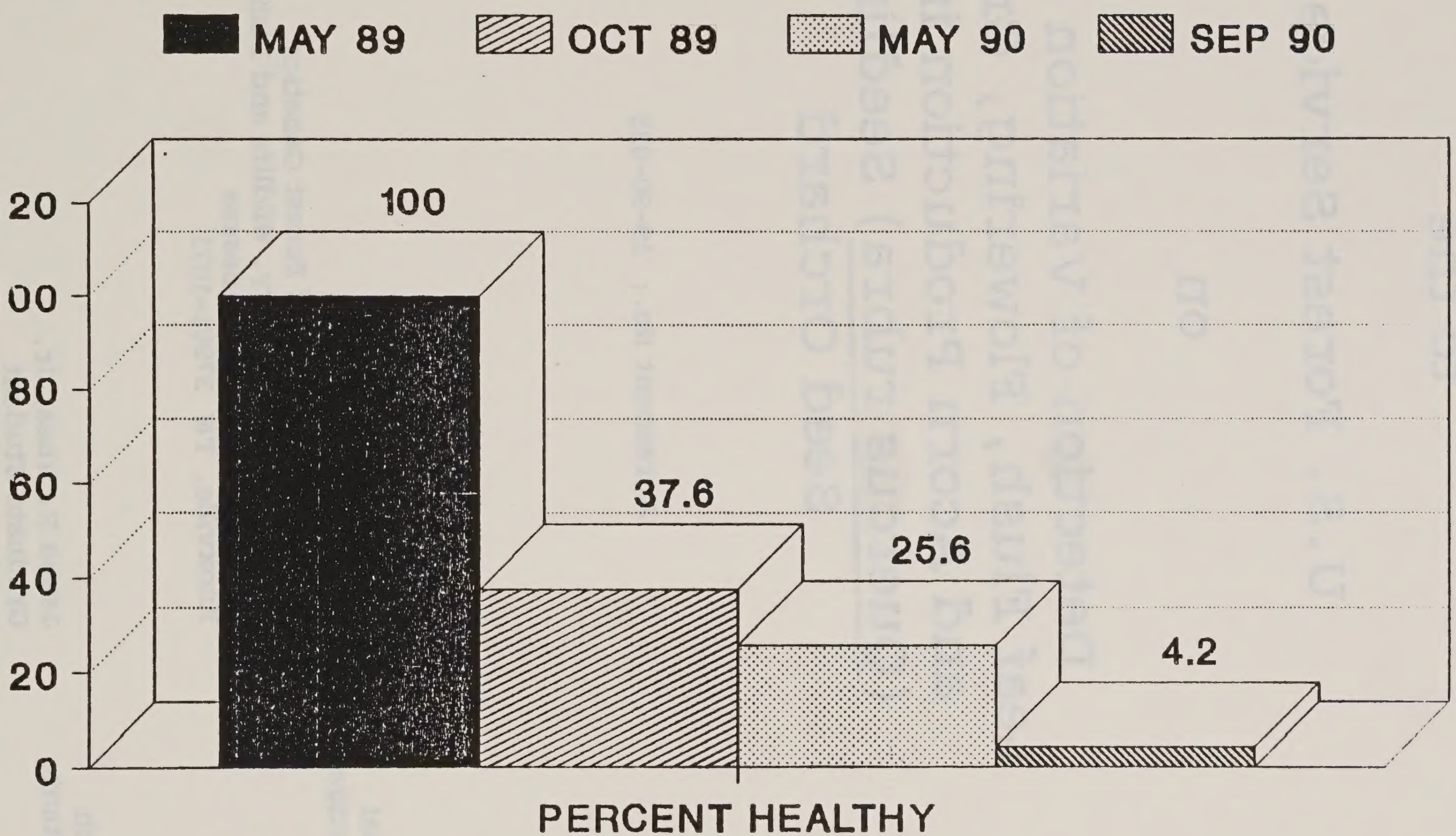
Location	Date BWA Detected	Date of Oldest "Rot Holtz"	Spruce/Fir[1/] Area
			hectares
Mt. Mitchell, N.C.	1955	?	502
State Park			1,514
Pisgah National Forest			348
Asheville Watershed			194
Blue Ridge Parkway			364
Private			2,922
Jonas Ridge Nursery, N.C.	1961	?	
Roan Mountain	1962	1958	
Pisgah National Forest, NC			562
Cherokee National Forest, TN			119 [2/]
			681
Blowing Rock Nursery, NC	1962	?	
Mt. Sterling	1963	1958	
Great Smoky Mountain National Park, NC			9,020
Great Smoky Mountain National Park, TN			6,656
			15,676
Grandfather Mountain (private), NC	1963	1959	440
Balsam Mountains, NC	1968	?	5,101
Pisgah National Forest			
Blue Ridge Parkway			
Private			
Great Smoky National Park, NC/TN			Average already included above for GSMNP
Clingmans Dome	1972	?	
Mt. Rogers National Recreation Area, VA	1979	1962	202
TOTAL AREA			25,022 [3/] [4/] [5/]

[1/] Average number of trees/Acre = 1,000-1,200
[2/] 324 ha of only red spruce on Unaka and Beauty Spot Mt. not included.
[3/] The isolated community in Nantahala National Forest not included. October 22, 1979
[4/] Isolated red spruce on Bald Mt. in Ashe Co.
[5/] Between 607 and 1012 ha estimated as privately-owned.

WATAUGA RED OAK SEED ORCHARD
FLOWER CROP 1990
FOLLOWED THROUGH TO 1991



WATAUGA RED OAK SEED ORCHARD
FLOWER CROP 1989
FOLLOWED THROUGH TO 1990



JAN 7, 1990

Progress Report

to the

U.S. Forest Service

on

Detection of Variation in Leaf Flush, Flowering, Growth and Acorn Production in a (*Quercus rubra*) Seedling Seed Orchard

Agreement No.: 19-90-035

Principal Investigator: Scott E. Schlarbaum
Associate Professor of Forest Genetics
Department of Forestry, Wildlife and Fisheries
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